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A PRELIMINARY INVESTIGATION

OF THE

SOIL AND WATER OF THE FAYUM PROVINCE.

BY

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INTRODUCTION.

The Fayum is a large oasis situated about fifty kilometres to the south-west of Cairo. It is separated from the Nile valley by a varying width of desert, and connected with it by a narrow strip of cultivated land through which the Bahr El Yusif, which forms the sole water supply, enters the oasis.

During the spring of 1901 about fifty samples of irrigation and drainage water, and about sixty samples of soil were taken from the east side of the Fayum and were examined in the Survey Department Laboratory in Cairo.

The mode of examination and the results obtained are here recorded.

The investigation was entirely of an introductory nature and does not claim to be anything more than a brief preliminary examination undertaken with a view to finding out in what direction future and more detailed work could be most profitably carried on.

The whole of the sampling was kindly undertaken by Mr. J. L. Beadnell, F.G.S., F.R.G.S., during the course of a Geological Survey of the district upon which he was engaged.

For a full description of the Fayum Oasis Mr. Beadnell's report should be consulted.

SOIL SAMPLES

Method of collection of the samples.—A hole was dug to the required depth (20 cm. in most cases) and a vertical slice of uniform thickness was cut away from one of the sides. This was put into a cotton bag and constituted the sample.

Treatment of the samples in the Laboratory before analysis.—The whole of the sample was put on to a zinc sieve having round holes 3 mm. in diameter, and sifted as long as anything passed through. The lumps left behind were then transferred to a mortar and broken by gentle pressure with a pestle, care being taken to avoid crushing any of the stones present, and again sifted. This treatment was repeated until nothing was left on the sieve except stones and rock fragments, which were rejected. The several fractions that passed through the sieve were well mixed and transferred to a glass bottle, from which the portions required for analysis and for the moisture determination were taken.

Method of analysis.—Owing to the large amount of other work on hand, and to the shortness of the time that could be given to the investigation, any complete mechanical or chemical analysis of the samples was quite out of the question, and the most that could be done under the circumstances was to determine the nature and amount of the constituents that would be injurious to the crops. Hence the analysis resolved itself into the preparation of a water solution containing the soluble salts and the determination of those salts.

How best to prepare the necessary water extract was therefore the first problem. It is well known that to thoroughly wash even a small portion of soil perfectly free from soluble matter is by no means easy. The washing takes a considerable time, results in a large bulk of solution, and is rarely really effective on account of the great retentive power of soils for soluble salts.

The difficult and tedious process of washing was therefore not attempted, the following method being adopted instead.*

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* The United States Department of Agriculture uses a method somewhat similar to this in its main features but different from it in several important details. Report No. 64.

Twenty grams of the sample were placed in a 250 c. cm. flask, water was added and the whole well shaken. After standing sufficient time to allow the air bubbles to escape, the flask was filled up to the mark with water, shaken frequently during several hours, and finally allowed to stand overnight (approximately twenty hours.) The greater part of the supernatant liquid was then decanted through a dry filter, no attempt, however, being made to drain the residual mud.

Sodium Chloride and Sodium Sulphate.—Of the filtrate thus obtained two portions were measured out, one of 50 c. cm. in which the chlorine was determined volumetrically in the usual way, and the other of 100 c. cm. for the determination of the total sulphate.

The filtrate was usually, but not always, clear. In no case, however, was the turbidity sufficient to interfere with the end reaction in the chloride determination, but it was frequently enough to have invalidated the sulphate determination had the barium chloride been added to the turbid solution. It was found, however, on boiling the solution, after the addition of a few drops of hydrochloric acid (the usual procedure before precipitating with barium chloride) that the finely-divided suspended matter aggregated and formed a flocculent precipitate which could be readily filtered off. In all cases therefore in which the solution showed any turbidity this mode of clearing it was resorted to.

The method of preparing the water solution adopted involves two assumptions, both of which, however, appear quite justifiable. It is taken for granted in the first place that the whole of the soluble salts that are to be determined, such as sodium chloride and sodium sulphate, entirely dissolve.

It is also assumed that the salts in solution are uniformly distributed throughout the entire contents of the flask, and are present in the same proportion in the supernatant liquid as in the mud at the bottom. This latter assumption is borne out by the results of some experiments made to test it.

Moisture.—The moisture was determined by drying a portion of the sample to constant weight in a steam oven.

The amount of water present in the soils at the time of sampling was extremely variable owing to the fact that some of the samples were taken immediately after a heavy fall of rain, others were from recently irrigated ground, and others again from ground that was comparatively dry.

During transmission to the laboratory and while awaiting analysis, all the samples lost water by evaporation and some lost a considerable amount, and since no special air-drying was adopted, the percentage of moisture found represents neither that originally present nor that of air-dried samples, but simply an accidental amount that was determined in order that the analytical results might be calculated if necessary on the soils dried at 100° C.

Method of calculating the analytical results.—The true specific gravity of ordinary arable soil is usually 2·5. Hence soil being 2½ times as heavy as water, 20 grams of soil will occupy the same bulk as 8 grams of water, namely 8 c. cm. Therefore, in the preparation of the soil extract, when the solution is made up to 250 c. cm. it really contains only 242 c. cm. of water, the place of the remaining 8 c. cm. being occupied by the 20 grams of soil. Evidently then the 50 c. cm. and the 100 c. cm. of the solution taken for the chlorine and the sulphate determination respectively are not 0·2 and 0·4 of the whole, but are really 0·2066 and 0·4132. On this basis the percentages were calculated in every case.

Method of recording the analytical results.—Moisture.—As a percentage on the sample at the time of determination.

Chlorine and Sulphur Trioxide.—As percentage on the soil containing the amount of water recorded.

The chlorine and the sulphur trioxide are also shown expressed as sodium chloride and sodium sulphate respectively.

It is to be regretted that circumstances prevented the separate determinations of calcium, magnesium and sodium, but in the absence of these determinations it is convenient to express the whole of the chlorine in terms of sodium chloride, in which form it probably actually exists in the soil; it is also convenient to calculate the whole of the soluble sulphates as though they existed entirely as the sodium salts, although in every case a certain amount of calcium sulphate is probably also present, while in several instances, specially noted, the greater part of the sulphate is undoubtedly calcium sulphate. However by expressing the whole as sodium sulphate the maximum amount of this salt that can possibly be present is known.

Water samples.—The suspended matter was in every case filtered off and rejected before the various determinations were made.

The total solids, the chlorine and the sulphur trioxide only were determined, and are shown expressed as parts per 100,000.

The chlorine and the sulphur trioxide have also been calculated as sodium chloride and sodium sulphate respectively, in order to arrive at the maximum amount of these two salts that may be present.

Summary of the results and conclusions.—This preliminary investigation of the condition of the soil and irrigation water in the Fayum was undertaken with a view to ascertaining whether the soil was deteriorating in any way, and if so, the reason and the remedy.

Soil deterioration usually proceeds from one of two causes, either because the supply of some essential plant food is used up, or on account of the presence of some injurious material that acts as a poison and checks or prevents plant growth.

In the Fayum the danger was so manifestly one of the possible accumulation in the soil of injurious material that no attempt whatever was made to ascertain whether the amount of plant food was in every case sufficient to allow of full development of the crops. The investigation was strictly limited to the determination of the harmful constituents of the soil, which were found to be sodium chloride and sodium sulphate. Of these two salts the chloride is more harmful than the sulphate. Sodium carbonate was found to be practically absent in every case, none of the samples showing more than a faint alkalinity when the water solution was tested, and even this trace of alkalinity was doubtless partly, if not wholly, due to a small amount of calcium carbonate present in the solution.

Before being able to say definitely whether injurious salts are present in excess or not, it is necessary to know first to what extent they may occur without harmful results.

During the last few years a considerable amount of valuable work has been carried out in America by the Division of Soils of the United States Department of Agriculture under Professor Whitney.

As a result of this work the following limiting values for the various injurious salts have been adopted.*

Sodium Carbonate.	0·05 per cent. Minimum danger line.
	0·10 per cent. Maximum limit for growth.
Sodium Chloride and *Sodium Sulphate.*	0 to 0·25 per cent. Not harmful.
	0·25 per cent to 0·50 per cent. Harmful but not sufficient to prevent growth.
	Over 0·50 per cent. Excessive; maximum limit for growth.

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* United States Department of Agriculture, Report No. 64.

These figures are quite arbitrary, but seem to be justified by the facts.

With regard to the water supply no hard and fast line can be drawn between a water that is fit for irrigation purposes and one that is unfit. The amount of harmful salts that may be present in irrigation water before the crops are injuriously effected varies with the extent to which salts themselves occur in the soil, with the amount of evaporation and concentration after the application of the water, and with the conditions of drainage.

If the soil contains a large amount of harmful salts, and but little water of a high salt content is frequently applied, then evaporation will so increase the salts present in the soil that crops can no longer grow.

Again, water containing a comparatively large amount of injurious salts may be applied with perfect safety to land that is well drained, whereas the effects of the same water on badly drained land would be disastrous.

It was found in America that in one locality 500 parts of soluble matter per 100,000 parts of water might be taken as the extreme limit of endurance for plants, while 250 to 300 parts per 100,000 marked the danger point at which the results of the use of the water were uncertain. In another locality 300 parts of soluble matter per 100,000 was the extreme limit of safety.

It should be noted that of the total soluble matter contained in a water usually only about 50 per cent is harmful.

Of the forty-eight samples of water from the Fayum that were examined (excluding the sample of underground water, as also the sample taken from the lake, since neither of these waters are used for irrigation) only one contained more than 300 parts of soluble matter per 100,000 parts of water, and that sample was taken in April from what is practically the tail end of one of the large drains. Therefore the water, according to the American standard, during January, February, March and April, in all the channels (whether called canals or drains) that were sampled, was good and well adapted for irrigation, with the single exception mentioned (sample J). The sample with the next highest soluble salt content (sample AB) contained 168 parts of soluble matter per 100,000 parts of water. This water was the subject of complaint by the cultivators, and was stated to be of bad quality. Unfortunately, the soil irrigated by this water was not examined, but from the situation of the locality, which is on the lower ground near the lake, the land probably contains a fairly high proportion of injurious salts.

The remaining forty-six samples were all of good quality. It follows therefore that the water used for irrigation in the Fayum (so far as the investigation went) is so uniformly good that any excessive accumulation of injurious material in the soil cannot be due to the quality of the water supplied, but must arise from other causes.

On scrutinizing in the light of the American standards the figures obtained from the analyses of the soils, it is evident that even the land bearing good crops, in those portions of the Fayum from which samples were taken, is only comparatively good. The best samples are by no means free from harmful constituents, and in several instances the amount of injurious salts is so high that with a very slight increase only the crops would begin to suffer.

The figures are as follows:—

TABLE I.

CONDITION OF CROPS.		SODIUM CHLORIDE.			TOTAL INJURIOUS SALTS.		
		Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.
		%	%	%	%	%	%
Good and Fairly Good ..	33 Samples.	0·196	0·028	0·093	1·314	0·064	0·206
Poor	10 Samples.	1·219	0·028	0·274	3·561	0·260	1·171

NOTE.—The Total of Injurious Salts is arrived at by adding together the whole of the Chlorine expressed as Sodium Chloride, and the whole of the soluble sulphates expressed as Sodium Sulphate, and includes therefore a certain amount of sulphate existing not as Sodium Sulphate, but as Calcium Sulphate. (See *Method of Recording Analytical Results.*)

Three samples of subsoil from the cultivated land were examined, and in each case they contained a much larger proportion of injurious constituents than the surface sample. This may be readily seen from the following table:—

TABLE II.

SAMPLE.	No.	DEPTH TO WHICH TAKEN.	SODIUM CHLORIDE.	TOTAL INJURIOUS SALTS.
		centimetres	%	%
Soil	2	0 to 20	0·028	0·064
Subsoil	3	20 to 40	0·042	0·081
Soil	53	0 to 20	1·219	3·561
Subsoil	34	20 to 40	4·052	5·338
Soil	61	0 to 20	0·238	0·400
Subsoil	62	20 to 40	0·336	0·558

The sand from the surface of the desert just beyond the present limits of cultivation, together with the clays and limestones underlying it through which the outermost canals are cut, all contain a large amount of chloride and sulphate. The chloride exists as sodium chloride, the sulphate is practically all calcium sulphate derived from the gypsum originally with the clay. The details are given below:—

TABLE III.

No.	NATURE OF SAMPLE.	SODIUM CHLORIDE.	CALCIUM SULPHATE.
		%	
8	Desert Sand. To be brought into cultivation	0·281	Large Amount.
30	Clay. Canal bordering desert cut through this.	1·543	....
42	Clay. ,, ,, ,,	2·622	Large Amount.
43	Limestone. ,, ,,	0·322	....
54	Desert Sand. To be brought into cultivation	1·640	Large Amount.
65	Clay	1·808	Large Amount.

From these figures it seems clear that the ultimate source of the chlorides and sulphates is in the desert sand and the limestone and clays that underlie it.

All the efflorescences occurring on the surface of the ground that were examined were found to be mixtures of sodium chloride and sodium sulphate in varying proportions.

The following table gives the results of the analyses:—

TABLE IV.

No.	NATURE OF SAMPLE.	SODIUM CHLORIDE.	SODIUM SULPHATE.
		%	%
25	Efflorescence	7·49	92·51
27	,, ...	77·02	22·98
28	.. ..	3·43	96·57
29	,, ...	4·21	95·79

Sebakh or Sebakh Kufri, which consists of the remains of mud huts, debris of ancient villages, etc., and contains varying amounts of nitrates, potassium salts, and organic matter, is extensively used as a manure in

Egypt. Several samples of this Sebakh were examined for sodium chloride, with the following results:—

TABLE V.

No.	NATURE OF SAMPLE.	SODIUM CHLORIDE.
		%
26	Sebakh	4·52
31	"	2·10
76	"	2·45
373	"	2·54

Evidently the amount of sodium chloride present in the samples analysed is excessive.

During the progress of the survey one special fact forced itself upon the attention, namely, that throughout the Fayum the low lands are invariably sacrificed to the high. The level of the areas covered by efflorescences and of those places where the soil is either too bad to admit of any cultivation at all or else gives only the poorest of crops, is generally below that of the surrounding fields, and it is the drainage from the adjacent and higher ground, carrying with it an excess of injurious salts, that by percolating on to the lower ground is the cause of the injury. Over-irrigation without corresponding drainage accentuates the evil. Every excess of water used for irrigating the higher lands beyond that actually required for the growth of the crops injuriously effects the lower lands. The new high level canals are also responsible for similar mischief, since the seepage water from these canals, after washing the very salty limestones and clays through which the canals are cut (see Table III) drains on to the lower levels and there gives rise to an accumulation of harmful material or waterlogs the soil.

The remedies are obvious. The first and most important is effective drainage, but to this should be added the prevention of leakage from canals if possible, and under the present conditions of defective drainage, economy in the use of water.

SOIL AND WATER SAMPLES.

Soil Samples.

Number of Sample.	Nature of Crop, etc.	Depth to which Sampled.	Determined.			Calculated.			Remarks.
			Moisture.	Chlorine.	Sulphur Trioxide.	Sodium Chloride.	Sodium Sulphate.	Total Injurious Salts.	
		cm.	%	%	%	%	%	%	
1	Rank grass and tamarisk bushes. No cultivation	0 to 20	6·27	2·210	0·322	3·646	0·572	4·218	
2	Beans. Good crop	"	5·39	0·017	0·020	0·028	0·036	0·064	
3	Subsoil of No. 2	20 to 40	5·88	0·025	0·022	0·042	0·039	0·081	
4	Wheat. Good crop	0 to 20	5·63	0·059	0·047	0·098	0·083	0·181	
5	Crops harvested. Remains of maize and clover. Poor crops.	"	6·10	0·136	0·068	0·224	0·121	0·315	
6	Beans. Good crop	"	5·29	0·025	0·027	0·042	0·048	0·090	
7	Wheat.	"	5·70	0·034	0·027	0·056	0·048	0·104	
8	Gypseous sand, just beyond present limit of cultivation	"	1·84	0·170	0·982	0·281	1·744	2·025	The Sulphate is largely Calcium Sulphate
9	Barley. Poor crop. Edge of cultivation	"	2·63	0·017	1·180	0·028	2·095	2·123	
10	Beans. Good crop	"	3·17	0·043	0·039	0·070	0·069	0·139	
11	" "	"	3·09	0·034	0·033	0·056	0·059	0·115	
12	" "	"	6·21	0·068	0·043	0·112	0·076	0·188	
13	" "	"	5·07	0·025	0·031	0·042	0·055	0·097	
14	" "	"	5·69	0·076	0·669	0·126	1·188	1·314	" " "
15	" "		5·43	0·034	0·006	0·056	0·011	0·067	
16	" "	"	5·07	0·025	0·026	0·042	0·046	0·088	
17	" Poor crop. Not long cultivated	"	3·87	0·068	0·208	0·112	0·369	0·481	
18	Helba (Fenugreek). Poor crop. Edge of cultivation	"	5·07	0·136	0·843	0·224	1·497	1·721	" " "
19	Beans. Good Crop	"	6·45	0·043	0·034	0·070	0·060	0·130	
20	Helba. Fair crop.	"	7·24	0·059	0·020	0·098	0·036	0·134	
21	" "	"	6·53	0·068	0·028	0·112	0·050	0·162	
22	" Poor Crop	"	7·42	0·110	0·044	0·182	0·078	0·260	
23	Beans. Good crop	"	7·03	0·034	0·024	0·056	0·043	0·099	
24	" "	"	5·87	0·059	0·044	0·098	0·078	0·176	

33	Subsoil of No. 32..	30 to 60	11·51	1·538	1·894	2·538	3·363	5·901	„	„	
37	Beans. Good crop	0 to 20	6·24	0·059	0·036	0·098	0·064	0·162			
38	Wheat. „	„	8·07	0·068	0·036	0·112	0·064	0·176			
39	Rice ..	„	6·77	0·076	0·038	0·126	0·067	0·193			
40	Beans. Fair crop..	„	5·79	0·068	0·056	0·112	0·099	0·211			
41	„ Good crop	„	6·21	0·034	0·035	0·056	0·062	0·118			
42	Clay. Outermost canals cut through this ..	„	9·28	1·589	0·754	2·622	1·339	3·961	„	„	
43	Limestone. Outermost canals cut through this..	„	1·79	0·195	0·049	0·322	0·087	0·409			
44	From under area covered by Efflorescence No. 29 ..	„	5·43	0·612	1·141	1·010	2·026	3·036			
45	Beans. Good crop	„	7·28	0·093	0·086	0·154	0·152	0·306			
46	„ „	„	2·86	0·043	0·032	0·070	0·057	0·127			
47	Wheat. Fairly good crop ..	„	5·17	0·050	0·043	0·084	0·076	0·160			
48	Uncultivated ..		7·54	1·827	0·085	3·015	0·151	3·166			
49	Wheat. Good crop	„	6·64	0·059	0·034	0·098	0·060	0·158			
50	Beans. „	„	5·98	0·118	0·066	0·196	0·117	0·313			
51	„ „	„	6·87	0·101	0·203	0·168	0·360	0·538			
52	Wheat. Poor crop. Recently cultivated ..	„	6·83	0·101	0·090	0·168	0·160	0·328			
53	„ „ Edge of cultivation ..	„	6·31	0·739	1·319	1·219	2·342	3·561		„	„
34	Subsoil of No. 53..	20 to 40	8·16	2·456	0·724	4·052	1·286	5·338	„	„	„
54	Desert just beyond present limit of cultivation..	0 to 20	5·41	0·994	0·479	1·640	0·851	2·491	„	„	„
55	Uncultivated ..	„	4·79	0·425	0·768	0·701	1·364	2·065	„		„
56	Wheat. Poor crop. Recently cvltivated ..	„	3·45	0·110	0·479	0·182	0·851	1·033	„	„	„
57	Beans. Good crop	„	4·62	0·076	0·072	0·126	0·128	0·254			
58	Wheat. „	„	4·43	0·101	0·085	0·168	0·151	0·319			
59	Beans. „	„	5·99	0·110	0·085	0·182	0·151	0·333			
60	Helba. Poor Crop	„	5·61	0·101	0·784	0·168	1·392	1·460			
61	Wheat. „	„	6·56	0·144	0·091	0·238	0·162	0·400			
62	Subsoil of No. 61..	20 to 40	7·12	0·202	0·125	0·336	0·222	0·558			
63	Uncultivated ..	0 to 20	8·46	1·844	0·233	3·043	0·414	3·457	„	„	„
36	Subsoil of No. 63..	100	9·28	0·646	0·558	1·067	0·981	2·048			
64	Wheat. Good crop	0 to 20	6·28	0·025	0·017	0·042	0·030	0·072			
65	Gypseous clay ..	„	9·07	1·096	1·954	1·808	3·470	5·278	„		
66	Clover. Fair crop	„	4·07	0·051	0·044	0·084	0·078	0·162			
67	Wheat. Good crop	„	7·02	0·017	0·020	0·028	0·036	0·064			

Water

SAMPLES.	PLACE FROM WHICH TAKEN.	DETERMINED.—Parts pe							
		TOTAL SOLUBLE MATTER.				CHLORINE.			
		January.	February.	March.	April.	January.	February.	March.	April.
D. AH. AI. AT.	Bahr el Yusif Lahun	26·2	22·2	24·6	39·6	3·86	3·16	3·51	8·4
E.	.. Hawaret el Maqta	25·6	—	—	—	3·86	—	—	—
F. Y. AJ. AS.	„ Medinet el Fayum	25·6	21·4	25·0	37·0	4·91	3·51	3·86	7·7
G.	Biahmu	26·6	—	—	—	3·86	—	—	—
H. Z. AK.	Sannuris	29·2	24·4	27·0	—	4·21	3·51	4·21	—
I. AA. AL.	Fenus	44·6	103·8	47·8	—	9·83	35·12	11·23	—
AB.	Small stream near Fenus	—	168·8	—	—	—	64·62	—	—
K. AD. AN.	Bahr Tanhola	68·0	112·4	44·4	—	18·96	35·12	10·53	—
P.	Demoa	23·8	—	—	—	3·51	—	—	—
Q.	Ravine west of Demoa	86·2	—	—	—	26·69	—	—	—
O.	West of Sêla Station	78·2	—	—	—	20·36	—	—	—
B.	Small canal entering A.	45·0	—	—	—	8·42	—	—	—
A.	Bahr el Roda near Sêla	86·2	—	—	—	25·98	—	—	—
N. AF. AP. AW.	Sirsena	77·0	70·2	60·6	152·4	23·88	20·37	16·15	54·0
M.	Roda	77·4	—	—	—	23·18	—	—	—
L. AE. AO. AV.	Tamia	89·0	119·0	87·6	124·8	28·09	42·14	28·09	43·5
J. AC. AM. AU.	El Butts (just above Kafr el Saman)	101·2	140·0	120·6	349·8	33·01	47·06	38·63	126·4
R. AG. AQ. AX.	Main canal at Sêla	25·4	24·4	26·4	39·4	3·51	3·16	4·21	9·1
C.	Same as R, different date	26·2	—	—	—	4·21	—	—	—
S.	Outermost canal east of Sêla	25·4	—	—	—	3·86	—	—	—
T.	Outermost canal north-east of Sêla	26·2	—	—	—	4·21	—	—	—
U.	Same as T, different date	24·6	—	—	—	3·51	—	—	—
V.	Outermost canal east of Roda	26·2	—	—	—	4·21	—	—	—
W.	Outermost canal east of Tamia	23·2	—	—	—	3·51	—	—	—
X.	Underground water from salty land	5789·0	—	—	—	2830·6	—	—	—
AR.	Birket el Qarun	—	—	1342·0	—	—	—	558·4	—

Samples.

0,000.				CALCULATED.—Parts per 100,000.											
SULPHUR TRIOXIDE.				SODIUM CHLORIDE.				SODIUM SULPHATE.				TOTAL INJURIOUS SALTS.			
uary.	February.	March.	April.	January.	February.	March.	April.	January.	February.	March.	April.	January.	February.	March.	April.
·92	1·92	1·78	3·1	6·37	5·21	5·79	13·91	3·41	3·41	3·17	5·59	9·78	8·62	8·96	19·50
1·71	—	—	—	6·37	—	—	—	3·04	—	—	—	9·41	—	—	—
·26	2·19	1·85	2·74	8·10	5·79	6·37	12·74	4·02	3·90	3·29	4·87	12·12	9·69	9·66	17·61
·08	—	—	—	6·37	—	—	—	5·48	—	—	—	11·85	—	—	—
·88	2·40	2·06	—	6·95	5·79	6·95	—	5·11	4·26	3·65	—	12·06	10·05	10·60	—
4·46	10·01	5·21	—	16·22	57·96	18·54	—	7·91	17·78	9·25	—	24·13	75·74	27·79	—
—	14·68	—	—	—	106·65	—	—	—	26·06	—	—	—	132·71	—	—
·60	17·08	3·63	—	31·28	57·96	17·37	—	17·05	30·32	6·45	—	48·33	88·28	23·82	—
·78	—	—	—	5·79	—	—	—	3·17	—	—	—	8·96	—	—	—
·62	—	—	—	44·04	—	—	—	22·41	—	—	—	66·45	—	—	—
·49	—	—	—	33·59	—	—	—	18·63	—	—	—	52·22	—	—	—
·85	—	—	—	13·89	—	—	—	15·71	—	—	—	29·60	—	—	—
3·58	—	—	—	42·87	—	—	—	24·11	—	—	—	66·98	—	—	—
1·32	9·67	8·43	23·11	39·40	33·61	26·66	94·23	20·09	17·17	14·98	41·04	59·49	50·78	41·64	135·27
·70	—	—	—	38·25	—	—	—	19·00	—	—	—	57·25	—	—	—
·93	15·98	10·97	17·28	46·35	69·55	46·32	71·85	21·19	28·37	19·48	30·68	67·54	97·92	65·80	102·53
4·19	20·64	16·94	63·37	54·46	77·67	63·75	208·61	25·21	36·66	30·08	112·53	79·67	114·33	93·83	321·14
2·06	1·71	1·78	3·30	5·79	5·21	6·95	15·06	3·65	3·04	3·17	5·97	9·44	8·25	10·12	21·03
2·33	—	—	—	6·95	—	—	—	4·14	—	—	—	11·09	—	—	—
2·06	—	—	—	6·37	—	—	—	3·65	—	—	—	10·02	—	—	—
1·99	—	—	—	6·95	—	—	—	3·53	—	—	—	10·48	—	—	—
1·85	—	—	—	5·79	—	—	—	3·29	—	—	—	9·08	—	—	—
2·60	—	—	—	6·95	—	—	—	4·63	—	—	—	11·58	—	—	—
1·85	—	—	—	5·79	—	—	—	3·29	—	—	—	9·08	—	—	—
8·60	—	—	—	4671·5	—	—	—	760·00	—	—	—	5431·6	—	—	—
—	—	187·4	—	—	—	921·5	—	—	—	332·5	—	—	—	1254·1	—